REMARKS/ARGUMENTS

I. Introduction:

Claims 1, 11, 14, 23, 36, and 44 are amended, claims 4 and 8 are canceled, and new claims 48-51 are added herein. With entry of this amendment, claims 1, 9, 11, 14, 19, 20, 22, 23, 25, 27, 29, 31, and 33-51 will be pending.

II. Specification:

The specification has been amended to incorporate language set forth in the original claims. The language incorporated into the specification was contained in the original application (see, original claims 13 and 18, for example). Thus, no new matter has been introduced.

The specification has been amended to insert a "Background of the Invention" header to clarify the location of the Background of the Invention in the specification (page 1, line 8 - page 3, line 4). The objection to the specification should therefore be withdrawn.

III. Claim Rejections - 35 U.S.C. 112:

Claims 9, 25, 31, and 33 recite "adding up the calculated periodic worst-case delay associated with the routers along the path". Page 11 of the specification notes in reference to the invention previously described at pages 7-10 "In such a manner, for an aggregate of traffic, a periodic worst-cast queuing delay at each node in a network can be calculated. Values for each node can be periodically collected. To calculate a periodic worst-cast delay for a path, the periodic worst-case delay at each router in the path can be summed."

At page 19, line 16 - page 20, line 2, the specification describes how the traffic profile parameters (b and r) can be collected for every router in a network and path delay calculated using this data. In one embodiment, the periodic-worst-case delay is calculated from each burst-rate profile and allocated bandwidth, preferably at a central location. Alternatively, the delay can be calculated at each router (using the method set forth in the claims). In this case the collecting agent can merely collect the delay without collecting the r and b values. Since the delay is calculated at each router (using r and b values), and sent to a central location, there is no need to send the r and b values to the central location that is adding up the delays received from the routers. The delay is then calculated across the network for a selected path by summing the delay for each router in the path. The periodic worst-case delay is calculated as described in the specification and set forth in the claims. The periodic worst-case delay calculation may be performed at each router and sent to a central device or the parameters (e.g., burst parameter and share of output link bandwidth allotted to the queue, or associated rate and share of output link bandwidth) may be sent from each router to the central device and the periodic worst-case delay calculated for each device at the central device, which then adds up all of the periodic worst case delays. Referring to claim 9, for example, the calculated periodic worst-cast delay associated with the routers along the path is added (last paragraph of claim). Calculation of the periodic worst-case delay (regardless of where the calculation is performed) is therefore required, as set forth in the second and third paragraphs of the claim.

The specification thus describes how the limitations are used together. Accordingly, applicant respectfully requests that the rejection be withdrawn.

Applicant notes that the Examiner included claims 34, 44, and 45 in the 35 U.S.C. 112 rejection. However, the Examiner has not provided any support for this rejection or specified how these claims fail to comply with the written description requirement.

IV. <u>Claim Rejections - 35 U.S.C. 103</u>:

Claims 1, 11, 14, 19, 20, 22, 23, 27, 29, 35-37, and 40-45 stand rejected under 35 U.S.C. 103(a) as being unpatentable over "Network Traffic Characterization Using Token Bucket Model" (Tang et al.).

Claims 1, 14, and 23 have been amended to include the limitations of dependent claims 4 and 8.

The Background of the Invention of applicant's specification describes how average delay and periodic worst-cast delay can be obtained in conventional systems by direct measurement. This requires directly monitoring every packet passing through a queue. For example, a time stamp can be inserted into the header of each packet upon arrival and the delay until the packet leaves the queue can be calculated by monitoring when the packet leaves the queue and comparing it to the time stamped arrival time. The delays for all packets can be averaged to provide an average delay for the time interval and the largest delay identified as the actual periodic worst-cast delay. This conventional direct measurement is cumbersome. Another limitation is that direct measurement only provides information about current conditions. They do not predict how the system will perform under different traffic conditions or how the system will perform with a different allocation of resources. In contrast to these conventional systems, applicant's claimed invention, collects traffic data including packet size and arrival time of each packet during a time interval and calculates a periodic worst-case delay using a calculated burst parameter and a specified bandwidth (e.g., associated rate, negotiated rate).

Tang et al. describe network traffic characterization using a token bucket model. In the model, Tang et al. use a token replenishment rate r and a token bucket size b. Algorithms are presented to determine optimal b and r values. The paper describes traffic modeling using token bucket without queuing and defines bounds for b and r. Tang et al. also describe how to find an optimal b for a given r. The specification refers to Tang et al. simply to provide an example for calculating a best value for token bucket size (maximum burst size) b given a value of r. Tang et al. do not show or suggest calculating

a periodic worst-case delay as set forth in the claims. Rather than calculating worst-case delay, Tang et al. describe how to calculate token bucket parameters and minimal queue size for a given delay (see, for example, page 61).

In claim 1, for example, the periodic worst-case delay is calculated by dividing the burst parameter by a share of output link bandwidth allotted to the queue. As described in the specification, the associated rate is a specified bandwidth, which may be, for example, a negotiated rate agreed to by a customer sending traffic data. In a sincere effort to expedite prosecution, the claims have been amended to clarify that a traffic aggregate is a class of traffic and the associated rate is set to a rate negotiated between a customer and a provider for the class of traffic. This negotiated rate is used to calculate the burst-rate traffic profile and a burst parameter. After traffic is queued, it is sent out of the router on an output link. The output link has as associated output link bandwidth. Multiple queues can share an output link, with each queue allotted a share of the output link bandwidth. It is this share of the output link bandwidth that is used to calculate the worst-case delay.

The Examiner has failed to point to any teaching of collecting traffic data at a queue of a router, the queue associated with a class of traffic over a time interval, with the traffic data comprising packet size and arrival time of each packet arriving at the queue during the time interval, and using this specified traffic data to calculate a burst-rate traffic profile and periodic worst-cast delay.

In contrast to applicant's invention, conventional systems often use an average source rate at a server. Averaging the rate of flow masks extreme high values (e.g., occasional large delays). Claim 1 specifically refers to calculations which use both a share of output link bandwidth allotted to a queue and an associated rate (specified bandwidth), which are two distinct values.

Furthermore, conventional systems do not predict how the system will perform under different traffic conditions or with a different allocation of resources (e.g., change in specified bandwidth or change in share of output link bandwidth allotted to a queue).

Applicant's invention, as set forth in the claims, is particularly advantageous in that it allows for the worst-case delay to be analyzed under hypothetical conditions such as different output link bandwidth allocations. For example, when a customer and Internet service provider agree to the customer sending increased voice and video traffic, such traffic is burstier than data traffic, thus it is useful to have the capability to estimate the effect of an increase in bursty traffic on delay. The method and apparatus can be used to estimate the effect of an increase in bursty traffic on delay and can be used to tell how much additional bandwidth is needed to achieve a certain reduction in delay with existing traffic. For example, a service provider can use the calculated worst-case delay to determine how much additional bandwidth to allocate to a queue to achieve a desired decrease in delay. Furthermore, the claimed invention is rapidly adaptable to real time changes in traffic conditions and allows for analysis of worst-case delay under hypothetical conditions such as different output link bandwidth allocations. For example, the associated rate can be set to a hypothetical negotiated rate and similar calculations performed.

Applicant notes that in rejecting the limitations of dependent claim 4, the Examiner refers to applicant's Description of Specific Embodiments. This is not admitted prior art. The Examiner has failed to point to any teaching of using a negotiated rate in the calculation of a periodic worst-case delay as set forth in the claims. Also, with regard to the limitations of dependent claim 8, the Examiner again refers to applicant's Description of Specific Embodiments, which is not prior art.

Accordingly, claim 1 is submitted as patentable over the cited references.

Claim 11 specifies calculating a burst parameter and a burst-rate traffic profile, claims 14 and 27 require code that causes a processor to calculate a burst parameter and code that causes the processor to calculate a burst-rate traffic profile, and claim 23 specifies means for calculating a burst parameter for the collected traffic and means for calculating a burst-rate traffic profile. Claims 12, 14, 23, and 27, and the claims depending therefrom, are submitted as patentable for at least the reasons discussed above with respect to claim 1.

Claims 33-41 and 50, depending from claim 1, claims 46 and 51, depending from claim 11, claims 42-43 and 48-49, depending from claim 14, and claim 47, depending from claim 23, are submitted as patentable for at least the same reasons as their base independent claims.

With regard to the Examiner's rejection of claims 36, 37, 42, 43, 44, the Examiner has simply referred to applicant's Description of Specific Embodiments. Applicant's specification describes the claimed invention and provides examples of types of parameters that may be used for the associated rate in the claimed invention. Applicant's example embodiments are not prior art.

Applicant notes that the Examiner grouped claims 20 and 29 in the above rejection. However, applicant believes that these claims belong in the grouping with claims 9, 25, and 31, and are therefore addressed below.

Applicant also notes that the Examiner included claims 9, 25, and 31 in the rejection in view Tang et al. However, the Examiner addresses these claims in the rejection based on Tang et al. and U.S. Patent Application Publication No. 2002/0097726 (Garcia-Luna-Aceves et al.). Therefore, applicant will address these claims below.

Claims 9, 25, 31, 33, 34, 38-41, 46 and 47 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Tang et al. and Garcia-Luna Aceves et al.

Garcia-Luan-Aceves et al. disclose a method for maintaining reservation state in a network router. Applicant notes that Garcia-Luna-Aceves et al. was filed after the filing date of Applicant's invention and that only the subject matter contained in related provisional application No. 60/240,654, filed October 10, 2000 is prior art.

Claims 9 and 31are directed to a method, claims 20 and 25 are directed to an apparatus, and claim 29 is directed to a computer program product for estimating worst-case queuing delay along a path. The method includes collecting a rate parameter and a burst parameter, calculating a periodic worst-case delay associated with the rate and burst parameters for each router in the path, and adding up the calculated periodic worst-case delay associated with the routers along the path.

Claims 9, 20, 25, 29, and 31 are submitted as patentable for at least the reasons discussed above with respect to claim 1.

Moreover, the cited references do not teach adding up a periodic worst-case delay associated with routers along a path, as required by the claims. The Examiner refers to parameter τ_{ik} of Garcia-Luan-Aceves et al. with respect to this limitation. Parameter τ_{ik} is the propagation delay of a link (i, k). This is added to the waiting time at the shaper at the ingress node. Garcia-Luna-Aceves et al. do not add up calculated worst-case delays associated with routers along a path. Instead Garcia-Luna-Aceves et al. add propagation delay of a link to a calculated waiting time at a shaper at an ingress node (see paragraph [0063]).

Accordingly, it is respectfully submitted that the rejection of claims 9, 20, 25, 29 and 31 based on Garcia-Luan-Aceves et al. should be withdrawn and these claims allowed.

Claims 44 and 45, depending from claim 9 and claim 22, depending from claim 20, are submitted as patentable for at least the same reasons as their base independent claims.

Claims 40 and 46 are further submitted as patentable over the cited references which do not show or suggest calculating error of data by comparing collected data to a burst-rate traffic profile. In rejecting these claims the Examiner refers to paragraph [0089] of the Garcia-Luna-Aceves et al. patent application. This paragraph describes how flows with the same burst-drain-times can be merged without changing the burst-drain-time of the resulting flows. There is no discussion of calculating error of data or comparing collected data to a burst-rate traffic profile.

Claim 41 depends directly from claim 40 and is submitted as patentable for at least the same reasons as claim 40. Furthermore, claim 41 is submitted as patentable because none of the cited references show or suggest calculating a new burst parameter if an error of data is higher than a predetermined limit, as set forth in claim 41. Applicant's

claimed invention provides a burst parameter that only needs to be recalculated when the burst parameter fails to fit a current traffic profile.

Claims 38 and 47 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Tang et al. in view of Garcia-Luna-Aceves et al. and U.S. Patent Application Publication 2002/0073224 (Varma et al.). Varma et al. describe a method for determining burstiness of a traffic source and do not overcome the deficiencies of the primary references.

Applicant notes that the Examiner has not provided any support for rejection of claims 33, 34, and 35. Furthermore, in paragraph 15, the Examiner has not referred to the limitations of claims 19 and 22.

V. Conclusion:

For the foregoing reasons, applicant believes that all of the pending claims are in condition for allowance and should be passed to issue. If the Examiner feels that a telephone conference would in any way expedite the prosecution of the application, please do not hesitate to call the undersigned at (408) 399-5608.

Respectfully submitted,

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